

CLAIMS

1. A gas sensor comprising:

a gas sensing element extending in an axial direction, and having a gas contact part, which is brought into contact with a gas to be measured, at its front end;

a case that surrounds the gas sensing element in a radial direction in such a manner that the gas contact part protrudes from a front end of the case; and

a protector, formed into a bottomed cylinder, fixed to the case in such a manner that the protector covers the gas contact part of the gas sensing element, wherein

the protector is composed of an inner hollow-cylindrical portion, and an outer hollow-cylindrical portion which is provided coaxially with a side wall of the inner hollow-cylindrical portion with an air space in between, a bottom wall positioned at an utmost front end of the protector being formed by one of the inner hollow-cylindrical portion and the outer hollow-cylindrical portion,

plural number of outer-wall gas inlet openings are formed in a side wall of the outer hollow-cylindrical portion, with guiding bodies extending inward so that the gas to be measured is introduced to the air space,

plural number of inner-wall gas inlet openings are

formed in the side wall of the inner hollow-cylindrical portion, the inner-wall gas inlet openings being arranged nearer to the case than the outer-wall gas inlet openings so that the gas to be measured is introduced around the gas contact part, and, an outer circumferential face of the side wall of the inner hollow-cylindrical portion positioned opposite to the outer-wall gas inlet openings is formed so as to be parallel to an outer circumferential face of the side wall of the outer hollow-cylindrical portion or so as to have a slope-like shape with a diameter enlarging in an axial direction toward the bottom wall of the protector, and

a discharge opening for discharging the gas to be measured, which is introduced to inside of the inner hollow-cylindrical portion directly to outside of the protector, is formed in the bottom wall of the protector.

2. The gas sensor according to claim 1, wherein the inner hollow-cylindrical portion is formed into a bottomed cylinder, the outer hollow-cylindrical portion is formed into a bottomed cylinder, the inner hollow-cylindrical portion is passed through an insertion hole provided in a bottom wall of the outer hollow-cylindrical portion, so that the bottom wall of the inner hollow-cylindrical portion protrudes nearer to the front end than the bottom wall of

the outer hollow-cylindrical portion, the bottom wall of this inner hollow-cylindrical portion being made a bottom wall positioned at an utmost front end of the protector, in which the discharge opening is formed.

3. The gas sensor set forth in claim 2, wherein the side wall of the inner hollow-cylindrical portion, which protrudes nearer to the front end than the bottom wall of the outer hollow-cylindrical portion, has a taper part so that an outer diameter of the side wall becomes smaller toward the front end.

4. The gas sensor set forth in claim 3, wherein the bottom wall of the outer hollow-cylindrical portion has a taper part so that that an outer diameter of the bottom wall becomes smaller toward the front end.

5. The gas sensor set forth in claim 1, wherein the outer hollow-cylindrical portion is formed into a bottomed cylinder, and a bottom wall of the outer hollow-cylindrical portion is positioned nearer to the front end than the inner hollow-cylindrical portion, so that the bottom wall of the outer hollow-cylindrical portion is made a bottom wall positioned at the utmost front end, the discharge opening being formed on the bottom wall of the outer

hollow-cylindrical portion.

6. The gas sensor set forth in claim 5, wherein the bottom wall of the outer hollow-cylindrical portion is composed of a first bottom wall which is connected to the side wall of the outer hollow-cylindrical portion, and a second bottom wall disposed nearer to the front end than the first bottom wall, the discharge opening being formed in the second bottom wall, and a connecting side wall that connects the first bottom wall and the second bottom wall has a taper part so that an outer diameter of the connecting side wall becomes smaller toward the front end.

7. The gas sensor set forth in one of claims 2 to 6, wherein at least one drain hole is formed in a part, in the bottom wall of the outer hollow-cylindrical portion, which is positioned nearer to outside in a radial direction than the outer circumferential face of the side wall of the inner hollow-cylindrical portion.

8. The gas sensor set forth in one of claims 2 to 4, wherein

a drain hole is formed in a region of the side wall of the inner hollow-cylindrical portion which is positioned inside of the outer hollow-cylindrical portion, and

the drain hole is formed in such a manner that a front side edge, of an inner periphery of the drain hole, which is positioned at the front end in the axial direction of the protector is positioned nearer to the front end in the axial direction of the protector than a rear side edge, of an inner periphery of the outer-wall gas inlet opening positioned at an utmost front end of the side wall of the outer hollow-cylindrical portion, which is positioned at a rear end in the axial direction of the protector.

9. The gas sensor set forth in claim 8, further comprising

a second guiding body, one end of which is connected to the rear side edge of the inner periphery of the drain hole and the other end of which extends with an inclination so as to come close to a center, in a radial direction, of the protector from the rear side edge of the drain hole toward the front end of the protector.

10. The gas sensor set forth in claim 8, wherein a notch crossing to the axis of the protector is provided in a part of the side wall of the inner hollow-cylindrical portion, and a region at the rear end in the axial direction of the protector from this notch is stuck out inward in the radial direction in such a manner as to continue to the side wall

of the inner hollow-cylindrical portion, thereby, forming the second guiding body extending in the axial direction of the protector and the drain hole.

11. The gas sensor set forth in one of claims 8 to 10, wherein plural number of drain holes are provided in the side wall of the inner hollow-cylindrical portion, and

a total opening area of the plural number of drain holes is smaller than a total opening area of the plural number of inner-wall gas inlet openings.

12. The gas sensor set forth in one of claims 1 to 11, wherein

an angle of the guiding bodies extending from end parts of the outer-wall gas inlet openings is formed inward in a range from 35° to 70° , relative to a tangent line of an outer circumference of the outer hollow-cylindrical portion.